



Embracing Uncertainty in Complex Models of Social Care

Introduction

The two key challenges of modelling the future of social care are the uncertainty and complexity of the underlying societal processes. Individuals, policy makers, and businesses make decisions related to care in the face of many unknowns. These decisions can have surprising, and potentially undesirable outcomes. Within the Care Life Cycle project, we are exploring and designing methods of dealing with uncertainty and complexity in modelling social care. In this briefing paper we look into the origins of these challenges, and propose some ways of overcoming them. We also suggest practical ways in which modelling results - even though complex and uncertain - can still be used by policy makers, businesses and individuals to inform their decisions.

Uncertain Future of Social Care

Any future is fundamentally unknown, and modelling social care is no exception. Underlying demographic dynamics, while still uncertain, is considered one of the most predictable of social processes, at least looking ahead up to one generation. However, there are several complications that increase uncertainty. Statistical information may not be readily available. If it is available, it often comes from surveys, which bear sampling errors. Some analytical categories may be ambiguous, as is the case with self-reported health status. Unlike in natural sciences, modelling in social sciences does not have solid theoretical foundations - the existing theories are fragmented, and their predictive capacity limited. Given the lack of theories, the specification of analytical models for social care is ambiguous, and their parameters and covariates add another source of error. In modelling social care, all these uncertainties are combined and amplified.

Uncertainty and Complexity

Besides being uncertain, social care is also complex. There are many parties involved - individuals, their family members, other informal carers, formal care providers, health authorities, local and central government - whose independent decisions and actions can lead to the emergence of unforeseen outcomes. In care systems, there are feedbacks, too. Individual choices can lead to changes in policy decisions and in the way businesses operate, which in turn can lead individuals to alter their decisions again. Complexity of these processes means conventional statistical analysis is not well suited

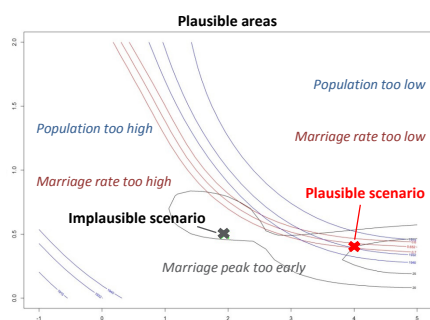
Key Points

- The future of social care is uncertain, and the underlying social processes are complex.
- The related research challenges can be addressed by using advanced statistical models known as meta-models (emulators), which link simulation model inputs and outputs.
- Statistical decision analysis can help individuals, businesses and policy-makers make informed decisions under uncertainty.

to capturing and describing all the uncertainties involved. On the other hand, the simulation methods typically used for modelling complex systems, such as agent-based models, do not address the issue of complex uncertainties in a coherent manner.

Overcoming the Challenges

Back in the 17th century, Sir Francis Bacon stated that: “if a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties.” For simulation models to reflect reality as well as possible, they should be built from the bottom up, based on empirical observations, and acknowledge all the uncertainties and complexities of social care. To achieve this, complex simulation models can be analysed using a method known as meta-modelling. Meta-models, also known as emulators, are advanced statistical models which link the inputs and outputs of the underlying computer model.



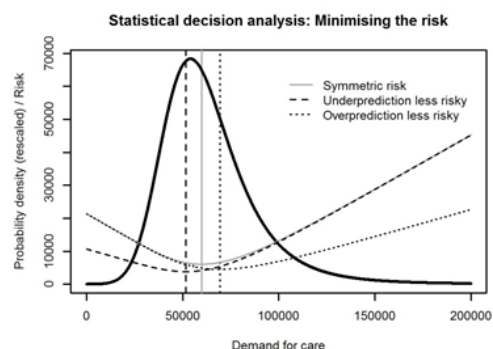
Emulators help explore the space of model parameters

Their results allow for a comprehensive analysis of uncertainty stemming from different sources, as well as calibrating the models so they remain aligned with the data, where available. Emulators can also help identify areas where the collection of additional information would be beneficial.

Towards Informed Decisions

The results of simulations can be used to aid decision making at a variety of levels. Analysing complex scenarios, using plausible parameter

settings identified through meta-modelling, can help decision makers explore the consequences of changing some parameters. This is an important tool for testing possible policy levers, business plans, or different decisions that individuals can make. Changes to model assumptions can also be examined in the same way. An uncertainty assessment is important, as it provides more information than individual scenarios alone. We can also apply decision analysis techniques to uncertainty. The probabilities of particular social care scenarios occurring are combined with the potential losses that a particular decision can cause.



Describing uncertainty: Not less, but more information for decision-makers

This approach is capable of providing bespoke and informed decision support, taking into account the distinctive needs of various decision makers.

Future research

In the world of meta-modelling and decision analysis, many research paths remain unexplored. We need to experiment with different computer simulation designs, various emulator types, and calibration methods. In addition, for decision analysis to work, we need to design an approach for working with decision makers to define loss functions. The ultimate aim of this work is to propose an integrated methodology for decision making under uncertainty in complex models of social care. Please contact us if you would like further information on the Care Life Cycle project, via email to clcproj@soton.ac.uk or telephone 023 8059 8981.

Authors

Jakub Bijak, Jason Hilton, Eric Silverman

Editor

Yvonne Richardson